Department of Forests, Mines & Energy

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CANADA

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Attached is a copy of "Third Year Survival and Heights of 1977 Plantations" dated December 1985.

This replaces the copy under the same title but dated October 1985. This revision is the result of the addition of information and tables to include natural softwood and hardwood regeneration data. There are also a few other minor changes and/or corrections incorporated throughout the report.

Please dispose of the October report in favour of this December report.
Thank you.

Timber Management Branch

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THIRD YEAR SURVIVAL AND HEIGHTS OF 1977 PLANTATIONS

NRNB

This Report has been prepared by
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DEPARTMENT OF FORESTS, MINES AND ENERGY
FREDERICTON, N.B.

MINISTER: HON. MALCOLM H. MACLEOD

Third Year Survival and Heights of 1977 Plantations

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ABSTRACT

Five thousand five hundred and seventy seven hectares were planted with jack pine (*Pinus banksiana* Lamb.), black spruce (*Picea mariana* (Mill.) B.S.P.), white spruce (*Picea glauca* (moench) Voss.), and larch (*Larix laricina* (Du Roi) K. Koch) in 1977. Three thousand three hundred and ninety-two permanent sample plots were established that year and remeasured in the first and third years following planting.

The average survival and height growth rates were significantly higher for planted trees of paper pot stock type than for bare root, with the exception of jack pine. The average height growth rate for jack pine of bare root stock type, from 1978 to 1980, was higher than for those of paper pot stock type.

A minimum density of 1500 trees per hectare including acceptable natural regeneration, (the minimum standard set for five (5) year old plantations), was not met in twenty (20) to fifty three (53) percent of the sample plots assessed in each management region.

A comparison of the mean survival percentages and mean height growth for various scarification methods indicated that there were many significant differences.

Key Words: bare root, black spruce (*Picea mariana* (Mill.) B.S.P.), jack pine (*Pinus banksiana* Lamb.), growth, larch (*Larix laricina* (Du Roi) K. Koch), paperpot, plantation, regeneration, scarification, survival, white spruce (*Picea glauca* (Moench) Voss).

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INTRODUCTION

The Province of New Brunswick has had an active tree planting program on Crown land since the early sixties. In 1977 the Forest Management Branch assumed the responsibility for monitoring all plantations on Crown land and a sampling program was initiated to monitor the survival of all plantations in that year and in subsequent years.

Using data collected from three thousand three hundred and ninety two permanent sample plots established on five thousand five hundred and seventy seven hectares planted in 1977, this report assesses the survival status of three year old plantations and in addition analyzes height growth rates for the various species, stock types, and scarification methods.

The results of the first year survival assessment for 1977 plantations has been previously reported.

METHOD

FIELD MEASUREMENTS

During plot establishment, all planted trees are numbered and their heights recorded. Re- measurement of the sample plots was completed one and three years after establishment. Planted trees were classified as alive, dead or missing and the heights of the living trees were recorded. In addition, third year remeasurement included a count of the natural regeneration by species. Only natural softwood trees greater than three centimeters and natural hardwoods greater than fifty centimeters in height were tallied.

STATISTICAL ANALYSES

The data was analysed using SAS (Statistical Analysis Systems). The sampling units used to calculate mean tree height growth rates were individual trees whereas the sampling units used to determine survival means were individual plots. An arcsine transformation was used to normalize the distribution of the tree survival data.

$$A' = \arcsin \sqrt{A}$$

Analysis of variance was used to determine whether differences existed among the means at the 95% confidence level. Gabriel's test was used to determine which means were

significantly different. This test was selected because of its suitability for unbalanced designs.

RESULTS AND DISCUSSION

SURVIVAL

The first and third year mean survival percentages, for each species and stock type combination, are shown in figures one and two, respectively. The survival rates for larch paperpot (33%), and for jack pine stryoblock (73%), shown in figure two, may be misleading since they are only based on very small samples, three and eleven plots respectively. For this reason the performance of jack pine styroblock and larch paperpot will not be included in further discussion. Appendix II contains the mean survival percentages, the total number of observations (plots); and the standard deviation, for each species, stock type, and region for measurements taken one and three years after the plantations were established in 1977.

There is little difference in regional survival rates for paperpot stock types, which range from 86% to 94% survival in the first year, and 82% to 91% survival in the third year. The mean survival rates for bare root stock types are inconsistent between regions and species groupings, ranging from 53% to 89% survival in the first year, with the exception of Region 2 where black spruce survival

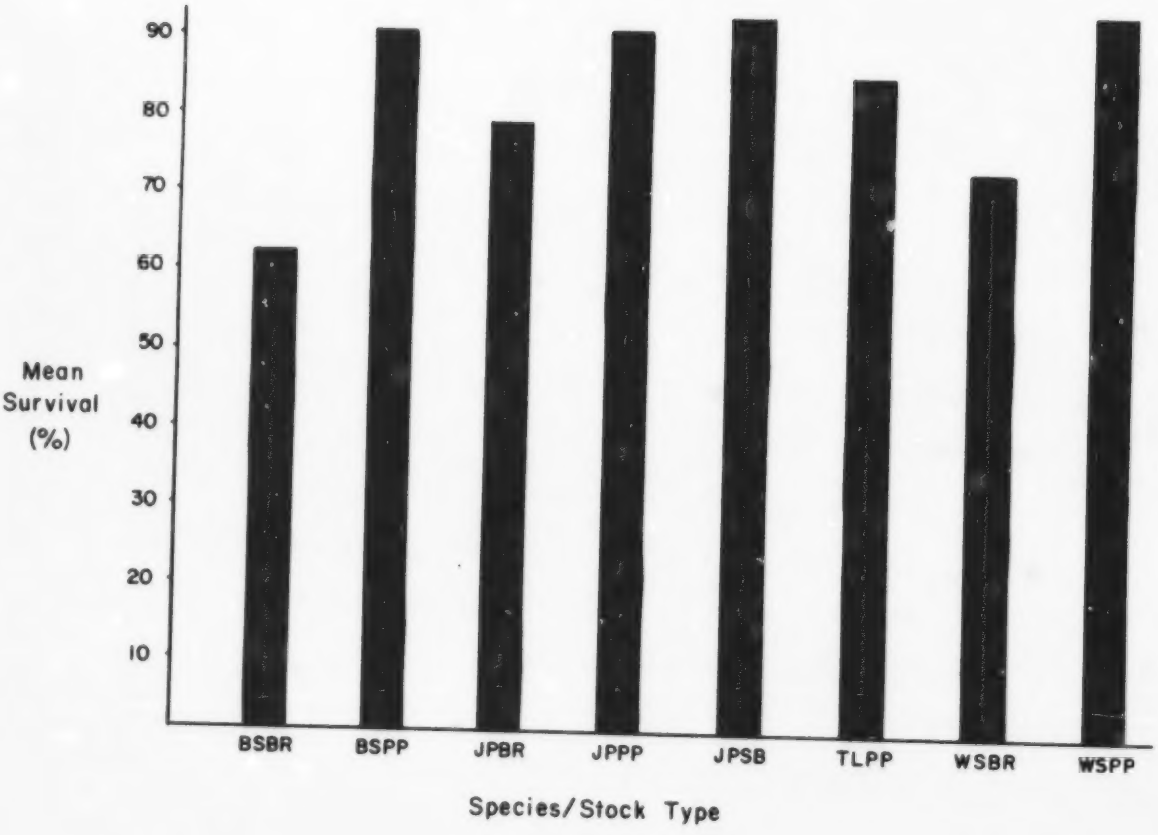


Figure 1. First year mean survival percentages for planted trees grouped by species and stock types. Abbreviations are explained on page 26.

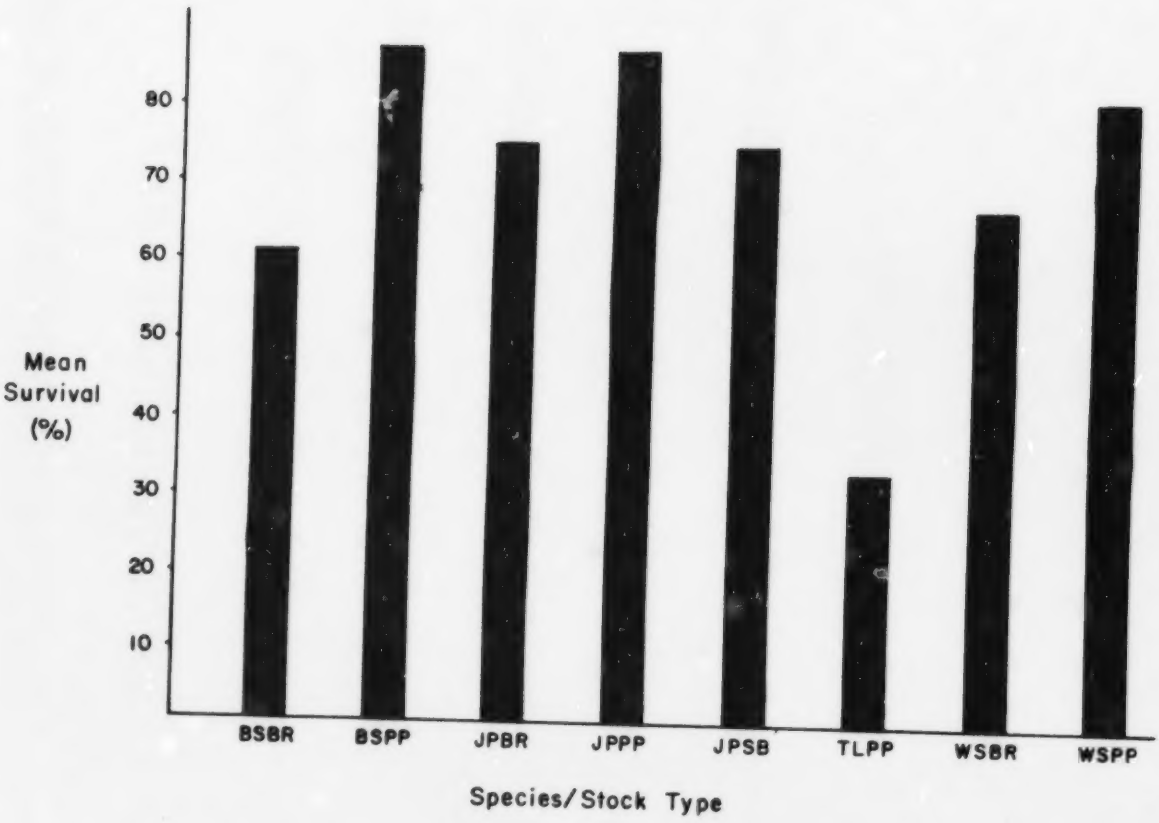


Figure 2. Third year mean survival percentages for planted trees grouped by species and stock types. Abbreviations are explained on page 26.

is 100%, but is based on only one plot. The third years survival rates range from 32% to 87%.

When measurements are considered grouped by species and stock type, ignoring regional boundaries, trends similar to those found in Appendix II exist in Appendix III. The range of survival rates is smaller between species for planted trees of paperpot stock type than for those of bare root stock type. This pattern exists for all calculations completed using the first and third year remeasurement data. In general, all planted spruce paper pots had significantly higher survival rates than species of bare root origin. There was no significant difference in the survival of jack pine paperpots compared to that of bare root stock.

The third year mean survival rates (grouped by species, stock type, and scarification method), are presented in Appendix IV. Table 1 indicates the significant differences that exist between the survival of planted trees on sites scarified by various methods. Not all scarification methods were available for comparison for each species/stock type combination. The highest survival rates for black spruce occurred on sites scarified with the root rake for bare root stock and on sites scarified with a bracke for paper pot stock type. Jack pine bare root had higher survival rates on sites scarified with the bracke, disc trencher, or burn and bracke, whereas, jack pine paperpots had highest survival rates on sites scarified with the finnish plow, disc trencher, or shark fin barrels (Table 1).

Table 1. The results of significance testing on the third year mean survival rates for planted trees grouped by species, stock type and scarification method.

Species	Stock Type	Scarification Method
Black Spruce	Bare Root	Root Rate* vs Bracke vs Shark Fin Barrels
	Paperpot	Bracke* vs No-site Preparation vs Finnish Plow
Jack Pine	Bare Root	Burn and Bracke* vs Shark Fin Barrels vs Burn vs No-site Preparation Bracke* vs No-site Preparation vs Burn vs Shark Fin Barrels Disc Trencher* vs Burn vs Shark Fin Barrels Shark Fin Barrels* vs Burn
	Paperpot	Finnish Plow* vs Bracke Shark Fin Barrels* vs Bracke Disc Trencher* vs Bracke

* significantly higher survival rates for planted trees

HEIGHT

The mean heights for planted trees measured at the end of growing intervals 1977-1978 (1st Year) and 1978-1980 (3rd Year) are presentrd in Appendix IV. At the time of planting the average height for planted trees of paperpot stock type is lower than that of bare root stock. However, by the end of the third year, the mean height growth for trees of paperpot stock type may be considered equal to those of bare root stock type, with the exception of jack pine.

The third year results revealed that the mean height for jack pine bare root was 19 cm taller than jack pine paperpot. The mean heights for both black and white spruce paperpots were four centimeters taller than those of bare root. The difference in height growth between paperpot and bare root, after one year, is five to six centimeters for both spruces and only one centimeter for jack pine.

The mean height growth for planted trees, grouped by species and stock type, for the two growth intervals (1977-1978 and 1978-1980), are shown in Figures 3 and 4. Significant differences of the mean height growth for the different stock types, grouped by species, are shown in Appendix V. Black and white spruce of paperpot stock type had significantly higher mean height growth for both growth intervals (1977-1978 and 1978-1980) than for those of bare

root stock. Although similar results were found for jack pine paperpot stock during the first growing season, jack pine bare root had significantly higher mean height growth rates than those of paperpot stock type during the second growth interval.

The results of significance testing on the mean height growth from 1978 to 1980, grouped by species, stock type, and scarification method are presented in Table 2. Height growth on no-site preparation was significantly higher for black spruce paperpot stock, than any of the following scarification methods: Root Rake, Shark Fin Barrels, Crusher or Bracke. Black spruce bare root had significantly higher height growth rates on sites scarified with Shark Fin Barrels. Jack pine bare root grew significantly better on sites scarified with Shark Fin Barrels, Disc Trencher, or Burn and Bracke. Jack pine paperpots showed the highest growth rates on sites scarified with Finnish Plows. Appendix VI presents the mean height growth from 1977 to 1978 and 1978 to 1980 for planted trees of different species and stock type combinations, grouped by scarification method.

Table 2. The results of significance testing on the mean height growth from 1978 to 1980, grouped by species, stock type and scarification method.

Species	Stock Type	Scarification Method
Black Spruce	Bare Root	Shark Fin Barrels* vs Root Rake vs Bracke
		Root Rate* vs Bracke
	Paperpot	Finnish Plow* vs Root Rake vs Shark Fin Barrels vs Crusher vs Bracke
		No-site Preparation* vs Root Rake vs Shark Fin Barrels vs Crusher vs Bracke
Jack Pine	Bare Root	Shark Fin Barrels* vs Burn & Bracke vs Burn vs Bracke vs No-site Preparation
		Disc Trencher* vs Burn & Bracke vs Burn vs Bracke vs No-site Preparation
		Burn & Bracke* vs Bracke
	Paperpot	Finnish Plow* vs Shark Fin Barrels vs Disc Trencher vs Burn & Bracke vs Crusher vs Bracke
		Disc Trencher* vs Bracke
		Crusher* vs Bracke
		Shark Fin Barrels* vs Disc Trencher vs Burn & Bracke vs Crusher vs Bracke

* significantly higher height growth for planted trees

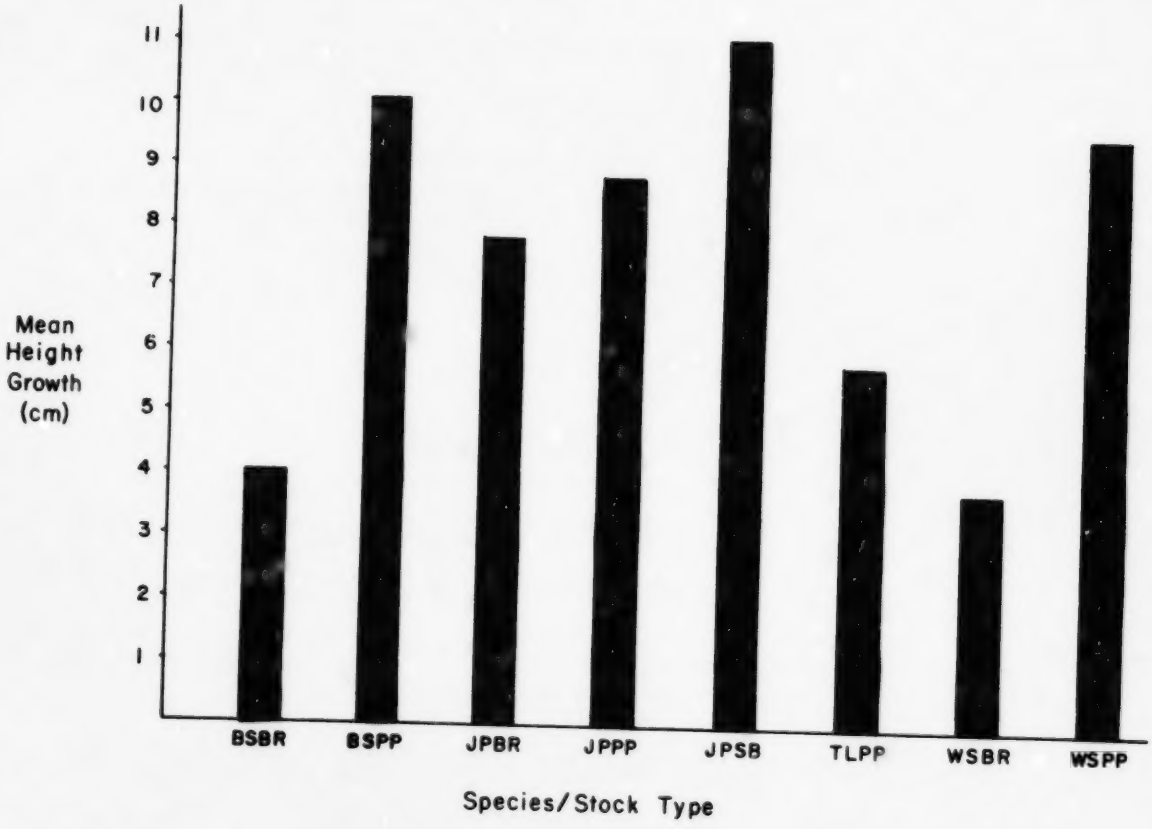


Figure 3. The mean height growth from 1977 to 1978 for planted types grouped by species and stock type. Abbreviations are explained on page 26.

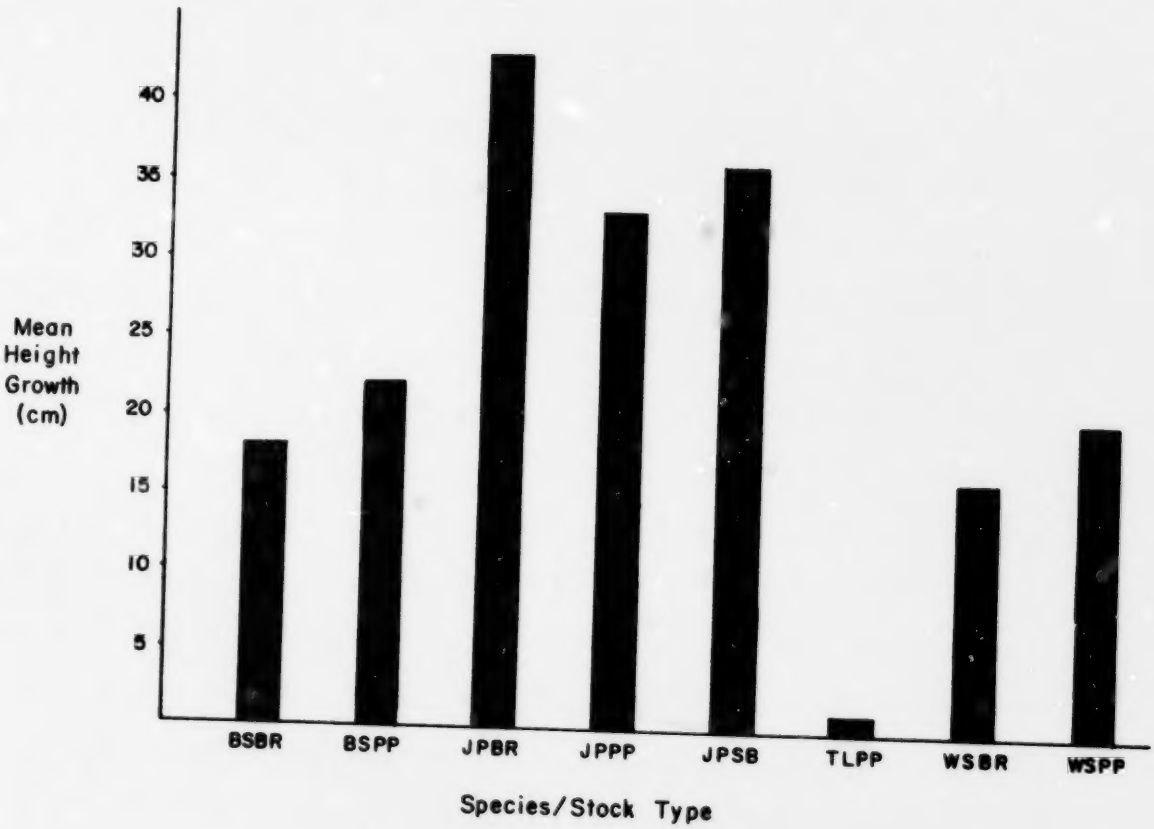


Figure 4. The mean height growth from 1978 to 1980 for planted types grouped by species and stock type. Abbreviations are explained on page 26.

DENSITY

The percentage of sample plots in each density class grouped by region, species and stock type, are presented in Tables 3 and 4. Figures 5 to 9 illustrate the percentage of sample plots versus the number of planted trees per hectare in each region.

For the purposes of this report, critical density standards three years after planting are assumed to be similar to those outlined in the 'Forest Management Manual of Crown Lands, 1984' for standards of plantation performance at year five. A criteria of not less than 1 500 softwood trees per hectare (excluding balsam fir) and not more than 3 000 trees per hectare (including all natural regeneration) must be achieved. Based on data collected in the third year and excluding natural regeneration, 56% to 60% of the sample plots in the various management regions had densities of less than 1 500 trees per hectare (Figures 5 to 9). The percentage of sample plots which had over 3 000 planted trees/ha ranged from one to nine percent. In order to meet the criteria set for the five year plantations, acceptable natural regeneration must be included in the density calculations. For the purpose of this forecast natural regeneration includes those acceptable species which are greater than or equal to three centimeters in height. As a result, 20% to 53% of the sample plots had a density of less than 1 500 trees/ha.

Table 3. The percentage of sample plots in each density class.

PLANTED TREES

REGION	First Year (1978) Percent of sample plots in each of the density classes (trees/ha)			Third Year (1980) Percent of sample plots in each of the density classes (trees/ha)		
	<1 500	1 500-3 000	>3 000	<1 500	1 500-3 000	>3 000
1	61	37	2	60	37	3
2	54	40	6	59	38	3
3	54	42	4	58	39	3
4	50	47	3	56	43	1
5	54	37	9	56	35	9

Table 4. The percentage of sample plots in each density class grouped by species and stock type.

PLANTED TREES

First Year (1978)

Species	Stock Type	<1 500 trees/ha Region 1	2	3	4	5	1 500-3 000 trees/ha Region 1	2	3	4	5	>3 000 trees/ha Region 1	2	3	4	5
BS	BR	96	-	-	-	63	4	-	-	-	29	-	100	-	-	8
BS	PP	52	-	55	59	48	42	-	42	41	42	6	-	3	-	10
WS	BR	-	-	-	-	61	-	-	-	-	32	-	-	-	-	4
WS	PP	-	-	-	-	62	-	-	-	-	29	-	-	-	-	9
JP	BR	58	67	58	70	-	42	32	41	29	-	-	1	1	1	-
JP	PP	60	48	51	38	-	39	43	43	58	-	1	9	6	4	-
JP	SB	-	-	-	71	-	-	-	-	29	-	-	-	-	-	-
TL	PP	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-

Third Year (1980)

		<1 500 trees/ha					1 500-3 000 trees/ha					>3 000 trees/ha				
BS	BR	97	-	-	-	64	3	-	-	-	29	-	-	-	-	7
BS	PP	94	-	59	64	50	6	-	38	36	39	-	-	3	-	11
WS	BR	-	-	-	-	65	-	-	-	-	28	-	-	-	-	7
WS	PP	-	-	-	-	62	-	-	-	-	33	-	-	-	-	5
JP	BR	63	70	61	61	-	37	29	38	28	-	-	1	1	1	-
JP	PP	64	55	54	45	-	35	41	40	54	-	1	4	6	1	-
JP	SB	-	-	-	71	-	-	-	-	29	-	-	-	-	-	-
TL	PP	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-

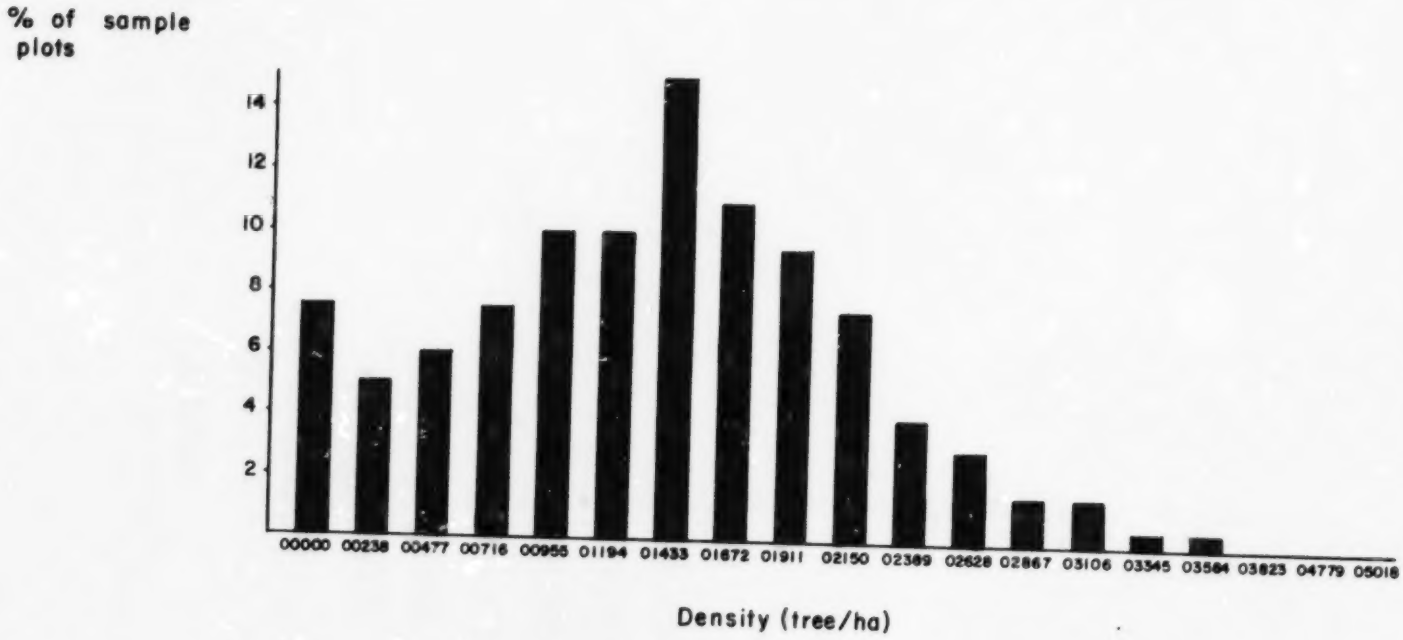


Figure 5. The percent of sample plots versus the number of planted trees per hectare - Region I.

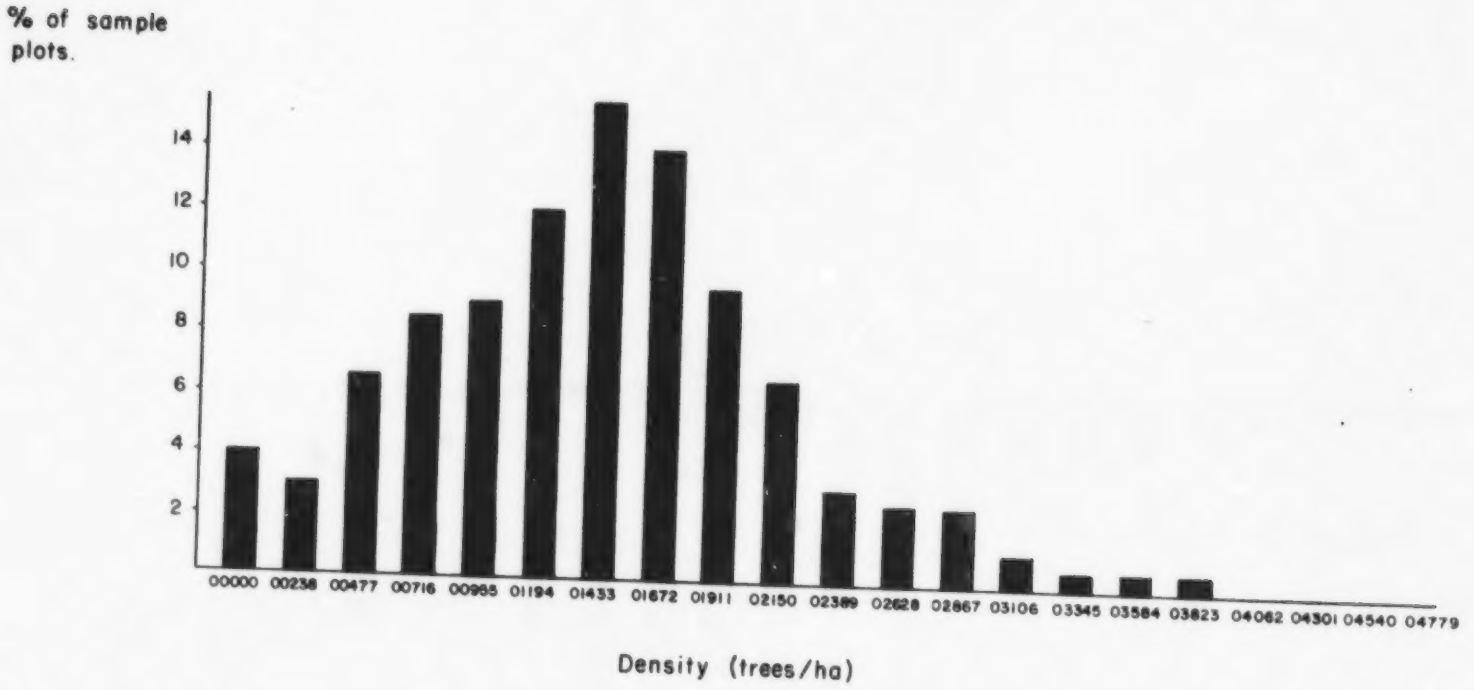


Figure 6. The percent of sample plots versus the number of planted trees per hectare - Region 2.

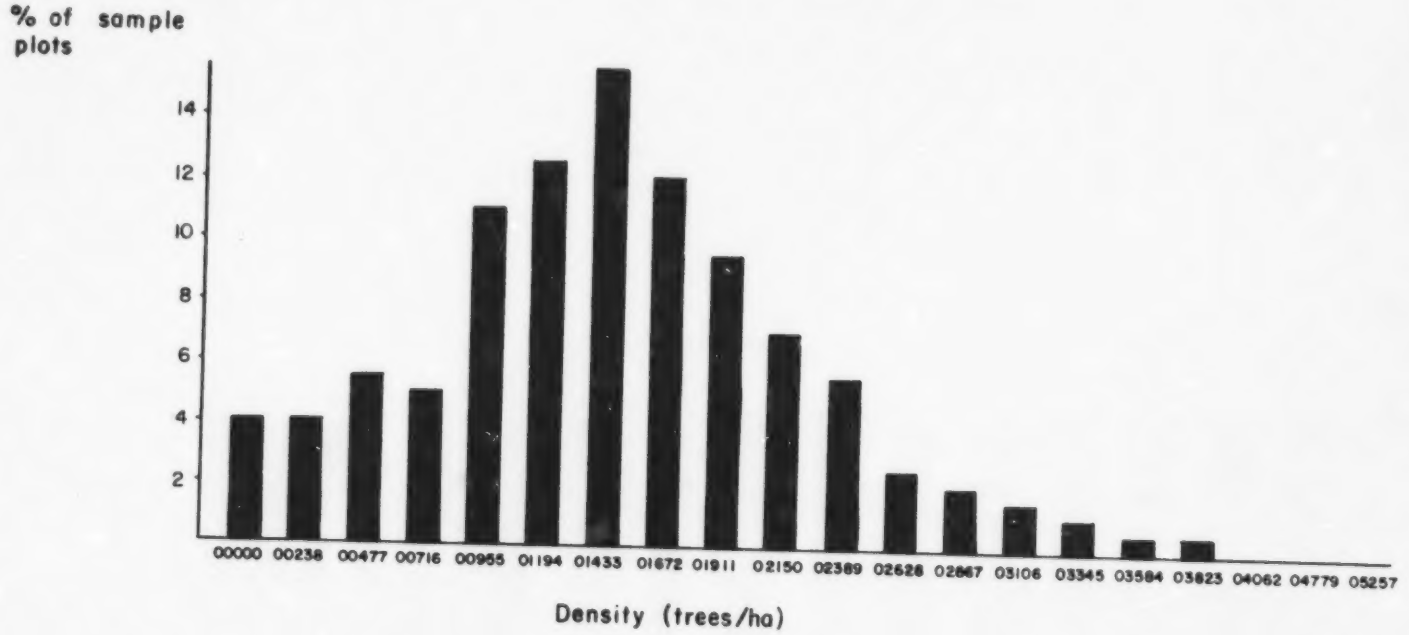


Figure 7. The percent of sample plots versus the number of planted trees per hectare - Region 3.

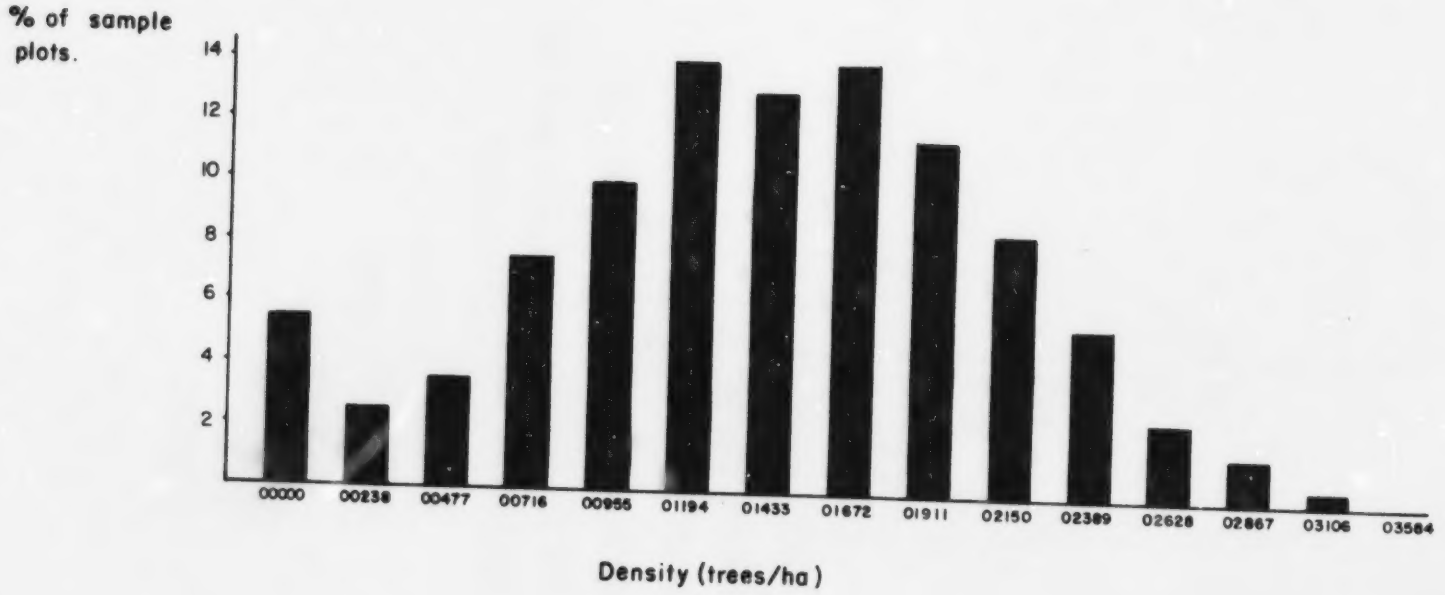


Figure 8. The percent of sample plots versus the number of planted trees per hectare - Region 4.

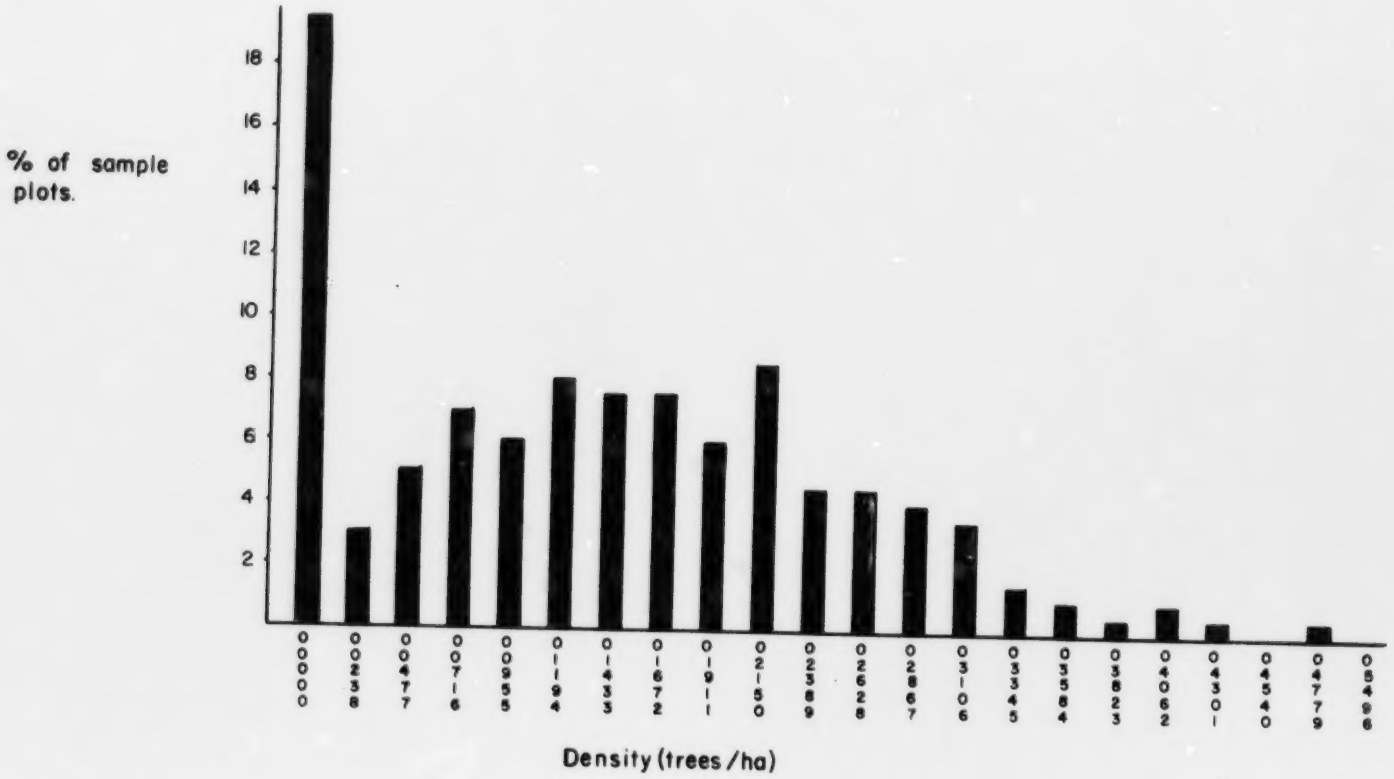


Figure 9. The percent of sample plots versus the number of planted trees per hectare - Region 5.

NATURAL REGENERATION

Comparisons among plots indicated that there was no direct relationship between the mean height growth of planted trees incurred from 1977 to 1978 or 1978 to 1980 and the total number of stems of natural regeneration. Also, when the survival percentages (calculated at the end of the first and third years) were compared with the total number of stems of natural regeneration, no direct relationship existed. The density of all stems including planted trees in third year assessment plots are compared in Table 5.

TABLE 5. DENSITY OF ALL STEMS IN THIRD YEAR ASSESSMENT PLOTS BY REGION FOR 1977 PLANTATIONS

REGION	LOCATION	PLANTATION	DENSITY (STEMS/HA)							
			PLANTED TREES	NATURAL SOFTWOOD				NATURAL HARDWOOD		
				SPRUCE	PINE	FIR	OTHER[1]	TOLERANT[2]	INTOLERANT[3]	OTHER[4]
1	Tracadie S.	P-1-77	1602	242	189	14	0	589	873	718
	Charlo Camp	P-4-77	756	374	25	2879	0	711	1565	4834
	Bass River	P-5-77	477	1048	23	1186	184	624	1032	655
	Tracadie S.	TP-1-77	1242	334	259	0	0	511	266	634
	Orolo Bk.	TP-2-77	1187	238	11	1774	11	1721	1281	4365
	Flemming Bk.	TP-3-77	1984	12	0	25	0	1435	359	785
	Nine Mile	TP-4-77	1235	449	0	1380	94	5143	1675	4388
	Lawson Bk.	TP-5-77	1347	298	99	106	192	457	2203	663
	Forty Four Mile	TP-6-77	1443	0	47	0	0	95	1003	3908
	Charlo Camp	TP-7-77	1225	346	5	1094	0	129	957	1547
	Lovalls Lk.	TP-9-77	1661	303	25	1214	67	1326	1003	3468
	Bass River	TP-10-77	1433	334	31	1274	0	254	1799	3536
	Dionne Gulch	TP-01-77	1911	0	0	0	0	1072	251	759
	Tilley Road	TP-001-77	1447	23	93	4	0	201	1789	763
2	Trout Brook	P-9-77	1240	0	1194	0	0	90	255	998
	Meadow Brook (1)	TP-12-77	1505	1935	692	0	0	167	740	0
	Bartibog R.	TP-13-77	1463	647	1856	0	9	4	472	84
	Six Mile Bk.	TP-14-77	1032	888	806	180	9	148	811	90
	Cold Brook	TP-15-77	1353	474	1058	157	242	892	397	1119
	Lr. Otter Bk.	TP-17-77	1318	1304	1727	204	9	139	562	373
	Meadow Bk. (2)	TP-012-77	1298	1688	208	1646	11	242	77	274

1. Cedar, Hemlock, Larch
2. Red Maple, Sugar Maple, Yellow Birch, Beech
3. White Birch, Poplar, Mountain Maple, Pin Cherry
4. Ash, Oak, Ironwood, Elm, Butternut, Basswood, Grey Birch, Silver Maple, Striped Maple, Willow, Serviceberry

TABLE 5. (cont'd)

REGION	LOCATION	PLANTATION	DENSITY (STEMS/HA) PLANTED TREES	NATURAL SOFTWOOD SPRUCE	PINE	FIR	OTHER	NATURAL HARDWOOD TOLERANT	INTOLERANT	OTHER
3	Nevers Bk.	P-11-77	1387	1187	473	753	0	1299	1893	1567
	Mountain Bk.	TP-19-77	1830	623	235	2608	9	2720	1347	2990
	Salmon R. (1)	TP-20-77	1460	668	362	377	86	511	1125	1646
	Schoals Dam (1)	TP-21-77	1166	132	2	780	9	1073	1477	654
4	Pocologan	P-12-77	1035	3720	7	6045	0	0	1877	318
	McDougal Lk.	P-13-77	1518	17	8	8	0	110	1058	1450
	Lee Settlement	P-14-77	1433	0	318	0	39	0	438	995
	Napadogan	TP-22-77	1574	372	0	1897	0	562	0	182
	Deersdale	TP-23-77	1720	256	0	3005	0	519	69	27
	Napadogan	TP-24-77	1533	516	0	2065	0	292	739	92
	Napadogan Bk.	TP-25-77	1079	1026	0	4167	203	292	2353	238
	Lee Settlement	TP-26-77	1367	59	92	13	26	0	172	285
	Lee Settlement	TP-27-77	1055	0	19	0	0	0	258	418
	McDougal Lk.	TP-28-77	1877	0	0	0	0	0	1170	955
	McDougal Lk.	TP-29-77	1172	0	0	0	0	86	1129	1238
	McDougal Lk.	TP-30-77	887	17	0	0	0	0	1501	2594
	Pocologan Sta.	TP-31-77	1649	222	26	0	132	0	3115	3
5	Plaster Rock	P-6-77	625	292	116	828	106	923	578	106
	Quisibis R. (1)	P-7-77	816	112	0	1433	4	97	1140	2901
	Moose Valley (2)	P-8-77	957	178	0	467	0	556	267	11183
	Quisibis R. (2)	P-007-77	1694	36	0	470	0	0	3591	3207
	Moose Valley (1)	TP-11-77	1514	56	0	1101	0	93	4667	5963

CONCLUSION

Both mean survival rates and mean height growth (calculated from data collected one and three years after plantations were established in 1977), were higher for planted trees of paperpot stock type than for planted trees of bare root stock, with the exception of jack pine. The mean height growth rate from 1978 to 1980, for jack pine of bare root stock type was greater than that for spruce of paperpot stock type.

Third year density calculations for the various management regions indicate that 35% to 43% of the sample plots satisfied the criteria of 1500-3000 planted trees per hectare. This represents only a slight decrease of less than 3% from the first year. As such the densities (Table 3) relate most directly to the number of trees planted per hectare at establishment rather than to the survival percentages presented previously.

A comparison of the mean survival percentages and mean height growth for various scarification methods indicated that there were many significant differences. However the true value of such comparisons (species, stock type, and scarfication method combinations) will become apparent if the same trends are displayed in subsequent years.

No direct relationship existed between the mean height growth rates of planted trees and the total number of stems of natural regeneration, within sample plots. The same result was found to exist between survival percentages of the planted trees and the natural regeneration.

CODES USED IN FIGURES, TABLES AND APPENDICES

Species

BS - black spruce
WS - white spruce
RS - red spruce
BF - balsam fir
JP - jack pine
RP - red pine
WP - white pine
EC - eastern cedar
EH - eastern hemlock
TL - tamarack or larch
RM - red maple
SM - sugar maple
YM - yellow maple
WB - white birch
MM - mountain maple
PC - pin cherry
PO - poplar
BE - beech
OHW - other hardwoods

Scarification Method

1 - Shark Fin Barrels
2 - Disc Trencher
3 - Finnish Plow
4 - C & H Plow
5 - Bracke
6 - Crusher
7 - Marden Roller
8 - Root Rake
60 - Herbicide
68 - Herbicide + Root Rake
80 - Burn
85 - Burn + Bracke
99 - No-site Preparation
98 - Other

Stock Types

BR - bareroot
PP - paperpot
SB - styroblock

0101 - BSBR
0102 - BSPP
0201 - WSBR
0202 - WSPP
0701 - JPBR
0702 - JPPP
0703 - JPSB
1102 - TLPP

N - total number of observations used in calculation

STD - standard deviation

Freq - Frequency

PERCNPLT - percentage of plots

DT - trees/ha

PLNUM - Plantation name

GROW78 - height growth from 1977 to 1978

GROW80 - height growth from 1978 to 1980

SUR78 MEAN - mean survival percentages

SUR80 MEAN - mean survival percentages

APPENDIX I. 1977 Plantations.

REGION	PLANTATION NAME	PLANTATION NO.	SPECIES	STOCKTYPE	HECTARES	SITE PREPARATION
1	TRACADIE S BR	P-1-77	JP	BR	162	Bracke
	NINE MILE WEST	P-3-77	BS	BR	172	Plow
	CHARLO CAMP	P-4-77	JP	BR	248	Barrels
	BASS RIVER	P-5-77	BS	BR	84	Bracke
	TRACADIE S BR	TP-1-77	JP	PP	99	Bracke
	FLEMMING BROOK	TP-3-77	BS	PP	129	Wild/fire
	NINE MILE EAST	TP-4-77	BS	PP	116	Plow
	BASS RIVER	TP-10-77	BS	PP	19	Plow
	LAWSON BROOK	TP-5-77	BS	PP	47	Bracke
	FORTY FOUR MILE	TP-6-77	BS	PP	36	Wild/fire
	OROLO BROOK	TP-2-77	BS	PP	195	Crusher
	LOVALLS LAKE	TP-9-77	JP	PP	189	Plow
	CHARLO CAMP	TP-7-77	JP&BS	PP	20	Barrels
	DIONNE GULCH	TP-01-77	JP	PP	40	Bracke
	TILLEY ROAD	TP-001-77	JP	PP	62	Bracke
2	TROUT BROOK	P-9-77	JP	BR	118	Wild/fire
	COLD BROOK	TP-15-77	JP	PP	393	Barrels
	BARTIBOG BRIVER	TP-13-77	JP	PP	102	Bracke
	SIX MILE BROOK	TP-14-77	JP	PP	191	Barrels
	MEADOW BROOK (1)	TP-12-77	JP	PP	32	Bracke
	MEADOW BK (2)	TP-012-77	JP	PP	88	Trencher
	LOWER OTTER BR	TP-17-77	JP	PP	85	Trencher/Crusher

APPENDIX I. (Cont'd)

REGION	PLANTATION NAME	PLANTATION NO.	SPECIES	STOCKTYPE	HECTARES	SITE PREPARATION
3	NEVERS BROOK	P-11-77	JP	BR	99	Barrels
	MOUNTAIN BROOK	TP-19-77	JP	PP	667	Barrels
	SALMON RIVER (1)	TP-20-77	BS&JP	PP	449	Barrels
	SCHOALS DAM (1)	TP-21-77	JP	PP	199	Barrels
4	POCOLOGAN	P-12-77	JP	BR	33	Trencher
	MCDOUGAL LAKE	P-13-77	JP	BR	34	Trencher
	LEE SETTLEMENT	P-14-77	JP	BR	7	Trencher
	POCOLOGAN STA	TP-31-77	JP	PP	117	Trencher
	DEERSDALE	TP-23-77	JP	PP	127	Barrels
	NAPADOGAN BROOK	TP-25-77	BS	PP	22	Full Tree
	NAPADOGAN	TP-22-77	BS	PP	40	Barrels
	NAPADOGAN	TP-24-77	JP	PP	55	Barrels
	MCDOUGAL LAKE	TP-29-77	JP&TL	PP	12	Trencher
	MCDOUGAL LAKE	TP-30-77	JP	SB	4	Trencher
	MCDOUGAL LAKE	TP-28-77	JP	PP	8	Trencher
	LEE SETTLEMENT	TP-26-77	JP	PP	47	Trencher
	LEE SETTLEMENT	TP-27-77	JP	BR&PP	10	Trencher
5	MOOSE VALLEY	TP-11-77	WS&BS	PP	523	RootRake
	MOOSE VALLEY (2)	P-8-77	WS	BR	225	RootRake
			BS	BR	74	Barrels
	QUISIBIS R. (1)	P-7-77	WS	BR	120	RootRake
	QUISIBIS R. (2)	P-007-77	WS	BR	84	RootRake
	PLASTER ROCK	P-6-77	BS	BR	84	RootRake

APPENDIX II. The Mean survival rates one and three years after plantation establishment, based on stock type and region.

Region	Species	First Year 1978 N	STD	Survival (%)	Third Year (1980) N	STD	Survival (%)
PAPERPOT							
1	BS	395	20	86	395	22	83
	JP	253	15	90	243	17	87
2	JP	363	18	89	363	22	82
3	BS	297	13	91	291	16	88
	JP	287	17	90	284	21	87
4	BS	59	12	94	59	14	91
	JP	228	11	94	228	19	87
	TL	3	17	84	3	30	33
5	BS	260	14	94	249	20	88
	WS	15	15	93	15	34	80
BAREROOT							
1	BS	131	30	53	30	25	32
	JP	263	25	80	261	28	76
2	BS	1	-	100	-	-	-
	JP	162	23	65	123	24	60
3	JP	166	21	79	166	22	77
4	JP	97	17	89	97	18	87
5	BS	75	23	77	75	24	72
	WS	55	23	71	55	23	67
STRYOBLOCK							
4	JP	11	11	93	11	35	73

APPENDIX III. Provincial Summary of mean survival percentage one and three years after plantation establishment.

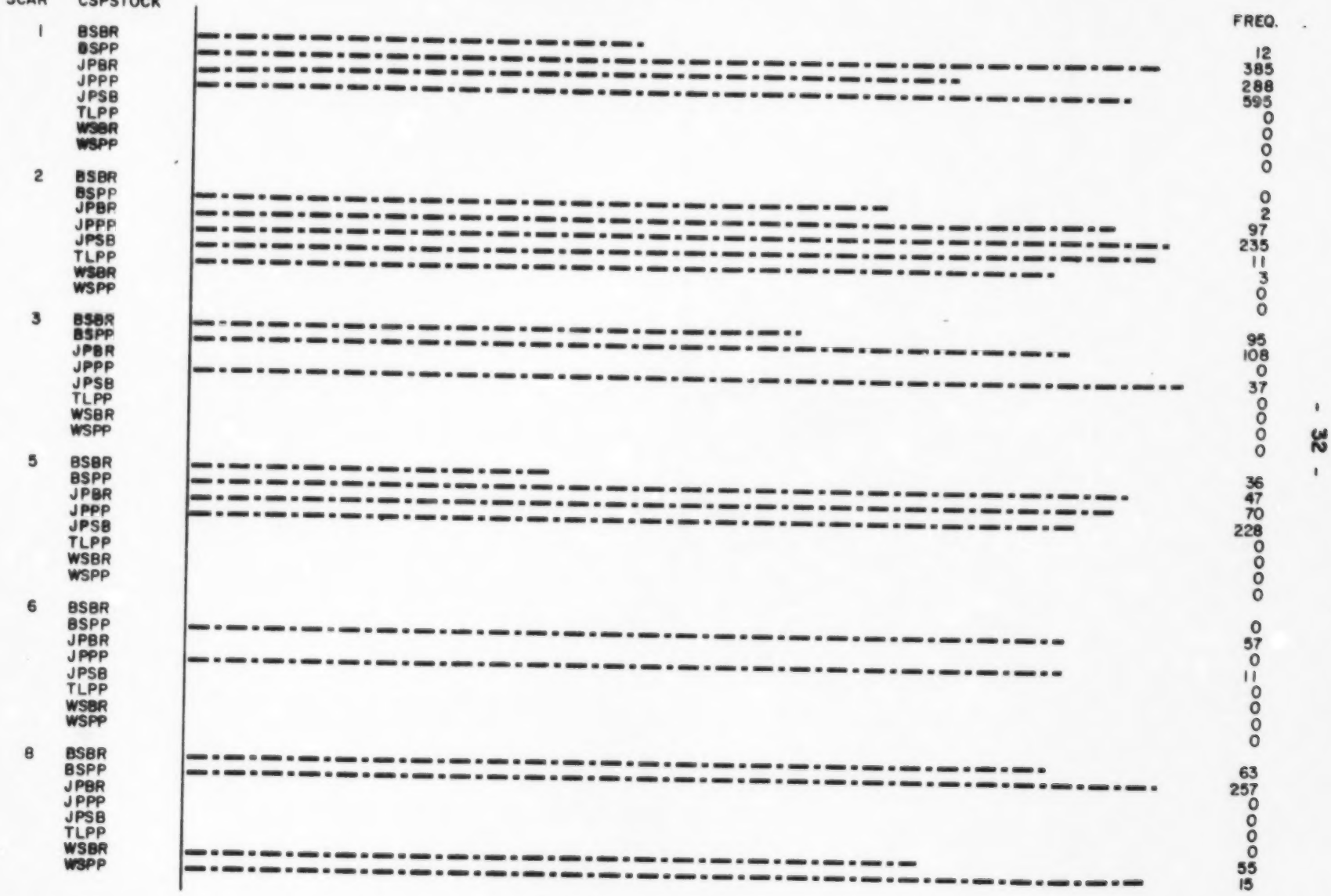
Species	Stock type	First Year (1978) N	STD	Survival (%)	Third Year (1980) N	STD	Survival (%)
BS	BR	207	30	62	105	31	61
BS	PP	1011	17	90	994	20	86
WS	BR	55	23	71	55	23	67
WS	PP	15	15	93	15	34	80
JP	BR	688	24	77	647	26	75
JP	PP	1131	16	91	1118	20	85
JP	SB	11	11	93	11	38	73
TL	PP	3	17	84	3	30	33

APPENDIX IV. First and third year survival rates by species, stock type and scarification method.

APPENDIX IV (cont'd)

SAS

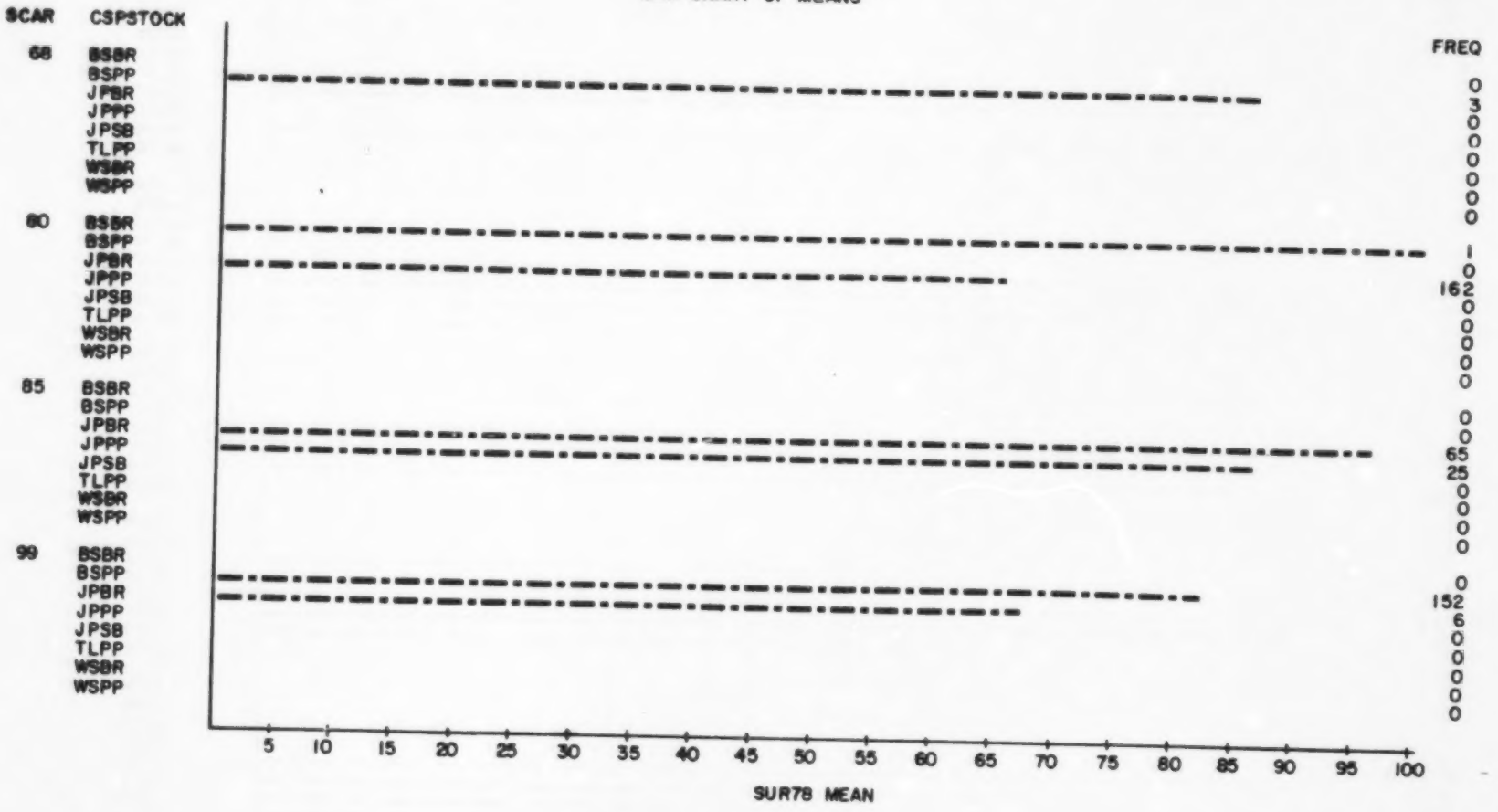
BAR CHART OF MEANS



APPENDIX IV (cont'd)

SAS

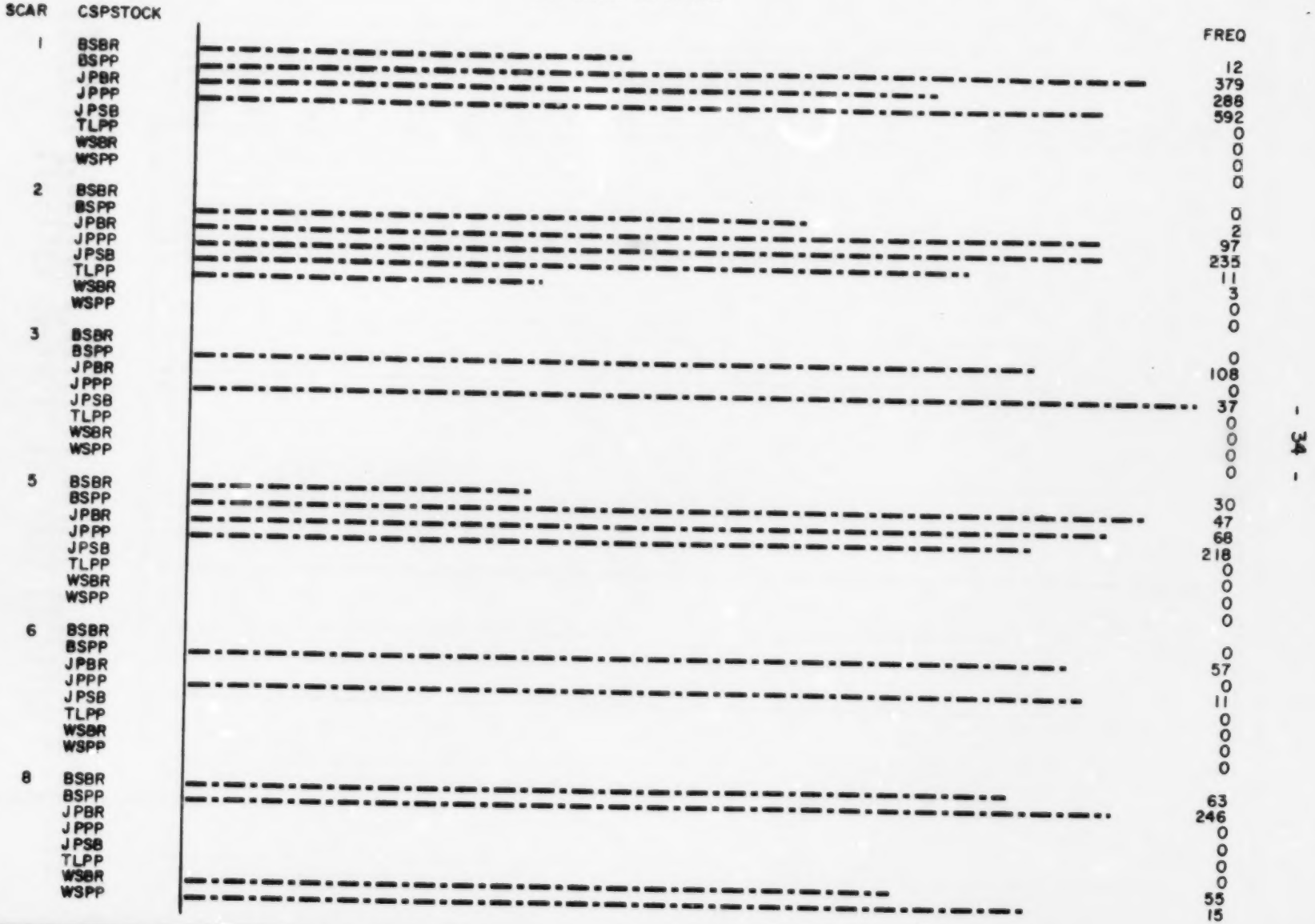
BAR CHART OF MEANS



APPENDIX IV (cont'd)

SAS

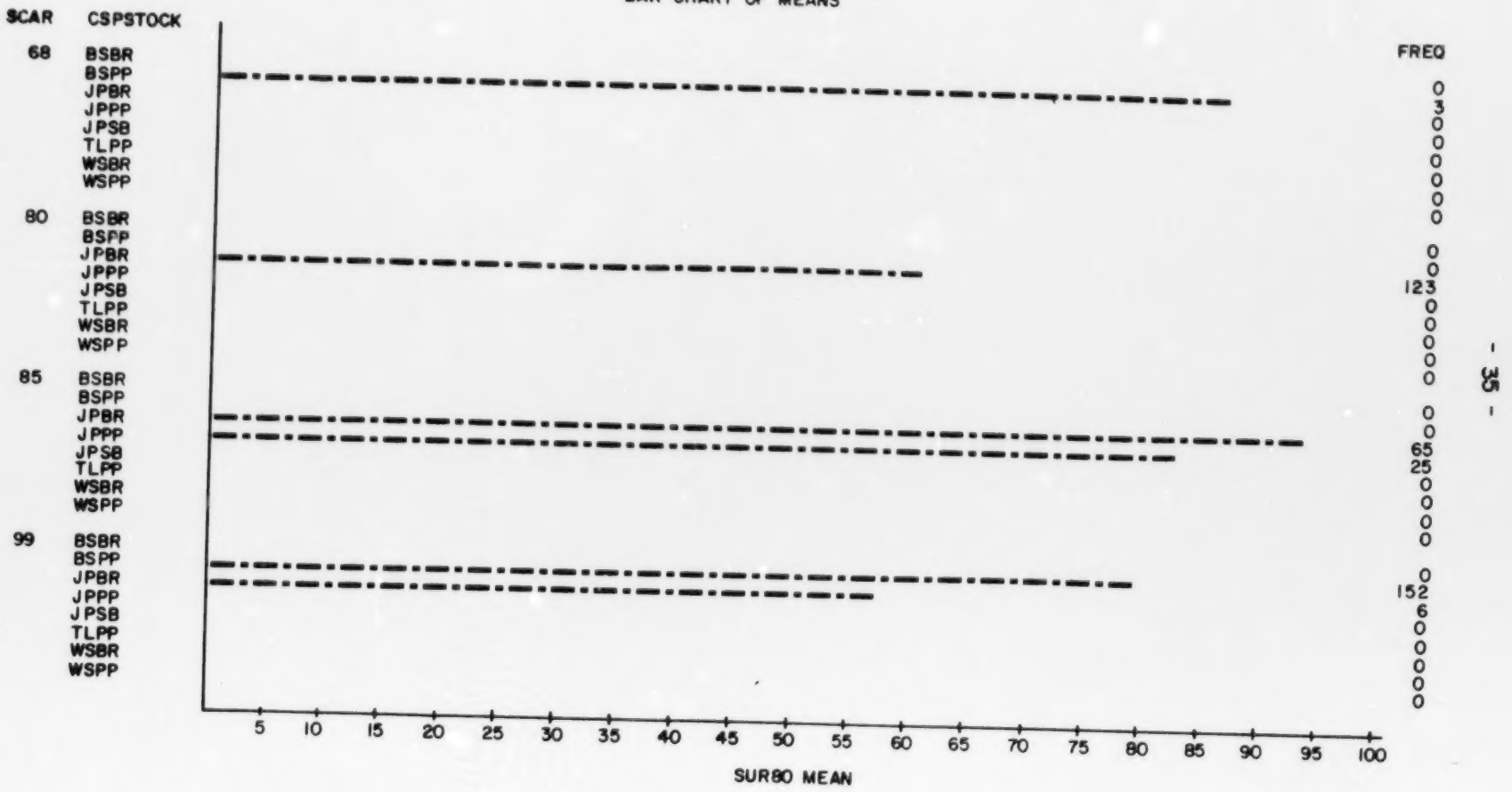
BAR CHART OF MEANS



APPENDIX IV (cont'd)

SAS

BAR CHART OF MEANS



APPENDIX V. Height performance for trees planted in 1977, grouped by species and stock type.

Mean Total Height

Species	Stock Type	Height (1977) (cm)	Height (1978) (cm)	Height (1980) (cm)
BS	PP	17	27	49
BS	BR	23	26	45
WS	PP	6	16	37
WS	BR	21	24	41
JP	PP	4	12	45
JP	BR	13	20	64

Height Growth 1978-1980 (comparison of mean height performance between stock types by species)

	BS			WS			JP		
Interval	N	Mean (cm)	Stock Type	N	Mean (cm)	Stock Type	N	Mean (cm)	Stock Type
1977-1978	6726	10 A*	PP	110	9 A	PP	6472	9 A	PP
	836	4 B	BR	443	4 B	BR	3836	8 B	BR
1978-1980	3994	22 A	PP	60	20 A	BP	4560	33 A	PP
	357	18 B	BR	242	16 B	BR	2388	43 B	BR

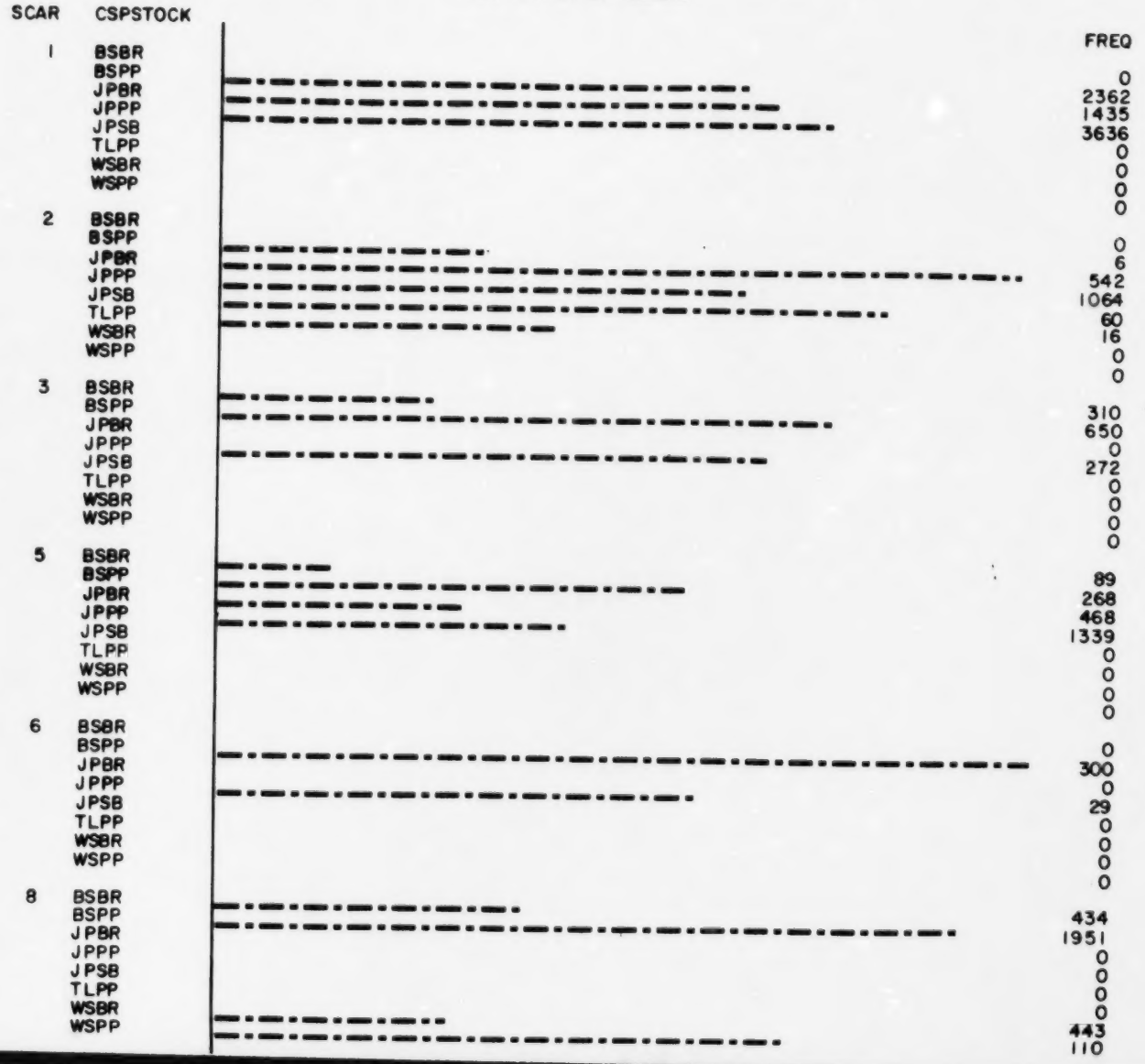
* A versus B indicates a significant difference exists between the stock types.

APPENDIX VI. The mean height growth from 1977 to 1978 and 1978 to 1980 for planted trees of different species and stock type grouped by scarification method.

APPENDIX VI (cont'd)

SAS

BAR CHART OF MEANS



APPENDIX VI (cont'd)

SAS

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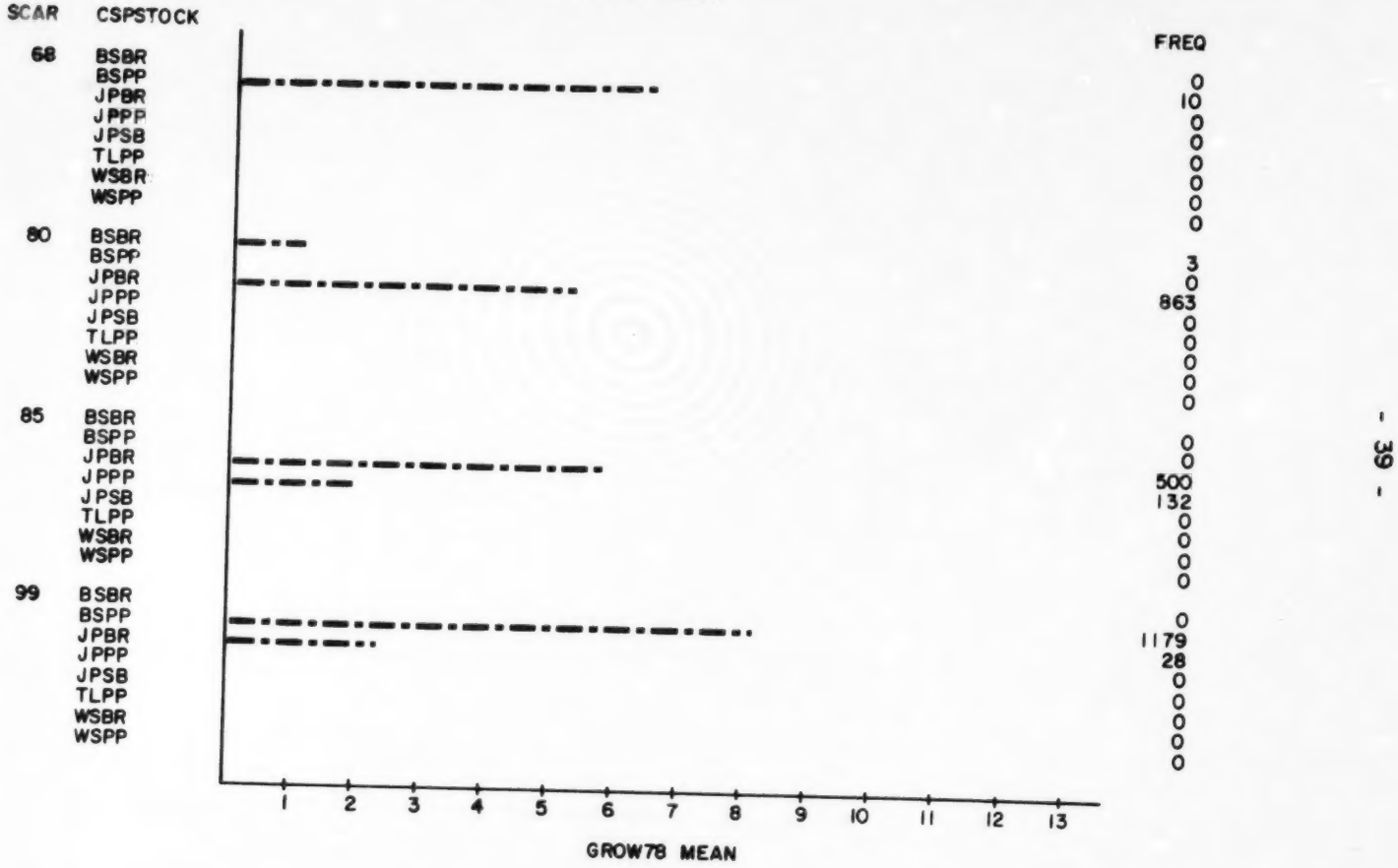

APPENDIX VI (cont'd)

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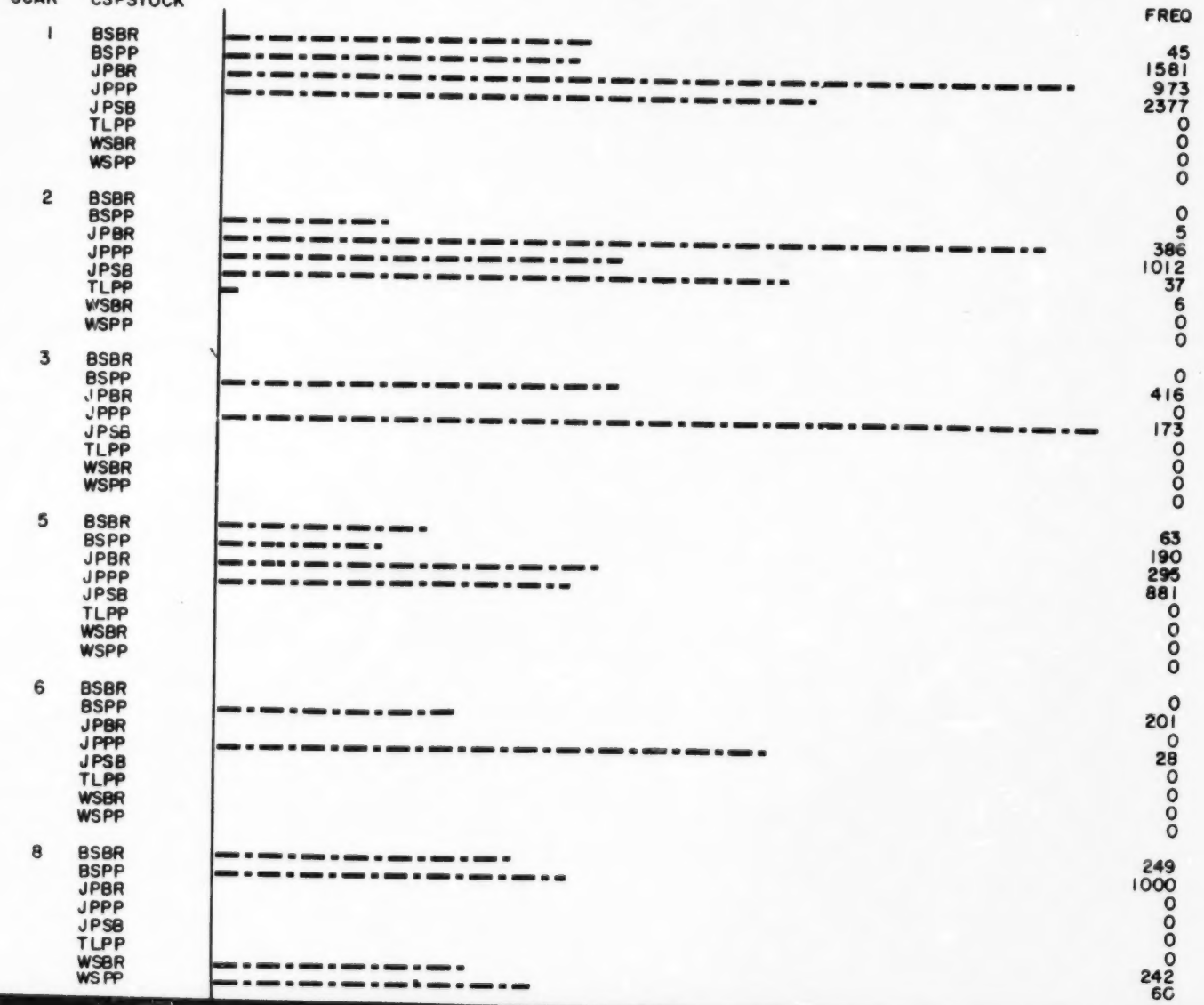
BAR CHART OF MEANS



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BAR CHART OF MEANS